

## Anexo 5. Software de asignación (GAMS)

```

sets
i      indice que denota el jefe de tripulación /JT1*JT12/
j      indice que denota el tripulante/Tr1*Tr12/
k      indice que denota la ruta /R1*R12/
l      indice que denota el vehiculo /CAM1*CAM12/
t      indice que denota el día /dia1*dia6/;

Table
Alfa (i,k)
      R1      R2      R3      R4      R5      R6      R7      R8      R9      R10     R11     R12
JT1   13      18      15      13      14      15      13      14      20      12      13      13
JT2   13      18      15      13      14      15      13      14      20      12      13      13
JT3   13      18      15      13      14      15      13      14      20      12      13      13
JT4   13      18      15      13      14      15      13      14      20      12      13      13
JT5   13      18      15      13      14      15      13      14      20      12      13      13
JT6   13      18      15      13      14      15      13      14      20      12      13      13
JT7   13      18      15      13      14      15      13      14      20      12      13      13
JT8   13      18      15      13      14      15      13      14      20      12      13      13
JT9   13      18      15      13      14      15      13      14      20      12      13      13
JT10  13      18      15      13      14      15      13      14      20      12      13      13
JT11  13      18      15      13      14      15      13      14      20      12      13      13
JT12  13      18      15      13      14      15      13      14      20      12      13      13
;

Table
Beta (j,k)
      R1      R2      R3      R4      R5      R6      R7      R8      R9      R10     R11     R12
TR1   13      18      15      13      14      15      13      14      20      12      13      13
TR2   13      18      15      13      14      15      13      14      20      12      13      13
TR3   13      18      15      13      14      15      13      14      20      12      13      13
TR4   13      18      15      13      14      15      13      14      20      12      13      13
TR5   13      18      15      13      14      15      13      14      20      12      13      13
TR6   13      18      15      13      14      15      13      14      20      12      13      13
TR7   13      18      15      13      14      15      13      14      20      12      13      13
TR8   13      18      15      13      14      15      13      14      20      12      13      13
TR9   13      18      15      13      14      15      13      14      20      12      13      13
TR10  13      18      15      13      14      15      13      14      20      12      13      13
TR11  13      18      15      13      14      15      13      14      20      12      13      13
TR12  13      18      15      13      14      15      13      14      20      12      13      13
;

```

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Table  
W(k,l)

	CAM1	CAM2	CAM3	CAM4	CAM5	CAM6	CAM7	CAM8	CAM9	CAM10	CAM11	CAM12
R1	17	17	17	17	17	17	17	17	17	17	17	17
R2	21	21	21	21	21	21	21	21	21	21	21	21
R3	17	17	17	17	17	17	17	17	17	17	17	17
R4	16	16	16	16	16	16	16	16	16	16	16	16
R5	17	17	17	17	17	17	17	17	17	17	17	17
R6	15	15	15	15	15	15	15	15	15	15	15	15
R7	18	18	18	18	18	18	18	18	18	18	18	18
R8	17	17	17	17	17	17	17	17	17	17	17	17
R9	18	18	18	18	18	18	18	18	18	18	18	18
R10	16	16	16	16	16	16	16	16	16	16	16	16
R11	10	10	10	10	10	10	10	10	10	10	10	10
R12	17	17	17	17	17	17	17	17	17	17	17	17

### Variables

ET Esfuerzo total.  
x(i,k,t) Variable binaria que asigna un jefe de tr a una ruta en t  
y(j,k,t) Variable binaria que asigna un tripulante a una ruta en t  
z(l,k,t) Variable binaria que asigna un vehiculo a una ruta en t;

### Free Variable

FT

### Positive Variable

CFSJT(i) coeficiente de frimat semanal del JT  
CFSTR(j) coeficiente de frimat semanal del Tripulante  
CFSCAM(l) coeficiente de frimat semanal del conductor

\*BJI(i)

\*BJJ(j)

\*BJL(l)

DmasI(i) desviacion por encima del promedio

DmenosI(i) desviacion por debajo del promedio

DmasJ(j)

DmenosJ(j)

DmasL(l)

DmenosL(l)

;

### Binary Variable

x(i,k,t)

y(j,k,t)

z(l,k,t);

\* Condiciones de personal en específico

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```
*conductores no pueden hacer ruta.
z.fx('CAM1','R6',t)=0;
z.fx('CAM2','R6',t)=0;
z.fx('CAM3','R6',t)=0 ;
z.fx('CAM4','R6',t)=0 ;
z.fx('CAM5','R6',t)=0 ;
z.fx('CAM6','R6',t)=0 ;
z.fx('CAM7','R6',t)=0 ;
z.fx('CAM8','R6',t)=0 ;
z.fx('CAM9','R6',t)=0 ;
z.fx('CAM1','R11',t)=0 ;
z.fx('CAM2','R11',t)=0 ;
z.fx('CAM1','R11',t)=0 ;
z.fx('CAM2','R11',t)=0 ;
z.fx('CAM3','R11',t)=0 ;
z.fx('CAM4','R11',t)=0 ;
z.fx('CAM5','R11',t)=0 ;
z.fx('CAM6','R11',t)=0 ;
z.fx('CAM7','R11',t)=0 ;
z.fx('CAM8','R11',t)=0 ;
z.fx('CAM9','R11',t)=0 ;
z.fx('CAM1','R12',t)=0 ;
z.fx('CAM2','R12',t)=0 ;
z.fx('CAM3','R12',t)=0 ;
z.fx('CAM4','R12',t)=0 ;
z.fx('CAM5','R12',t)=0 ;
z.fx('CAM6','R12',t)=0 ;
z.fx('CAM7','R12',t)=0 ;
z.fx('CAM8','R12',t)=0 ;
z.fx('CAM9','R12',t)=0 ;
```

### EQUATIONS

```
FO Ecuación de la FO
*ASIG(k,t) Restriccion de asignación de la tripulación
ASIGVR(k,t) Asignación de V a R
new1(k,t)
new2(k,t)
new3(i,t)
new4(j,t)
new5(l,t)
replJT(i,k)
replTR(J,k)
RBALANJT(i)
RBALANTR(j)
RBALANCAM(l)
RCFSJT(i)
RCFSTR(j)
RCFSCAM(l)
```

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```

*FO.. FT=e=SUM((i,k,t)$ (ord (t) gt 1),x(i,k,t)*Alfa(i,k))+Sum((j,k,t)$ (ord (t) gt 1),y(j,k,t)*Beta(j,k))+sum((l,k,t)$ (ord (t) gt 1),z(l,k,t)*W(k,l));
FO.. ET=e=SUM((i),DmasI(i)+DmenosI(i))+SUM((j), DmasJ(j)+DmenosJ(j))+sum((l), DmasL(l)+DmenosL(l));
*FO.. FT=e= Sqrt([(sum((i,k,t),sqr(x(i,k,t)*Alfa(i,k))+100)/6)-(sqr(90/6))]) +
* Sqrt([(sum((j,k,t),sqr(y(j,k,t)*Beta(j,k))+100)/6)-(sqr(90/6))]) +
* Sqrt([(sum((l,k,t),sqr(Z(l,k,t)*W(k,l))+100)/6)-(sqr(90/6))]);
*ASIG(k,t).. Sum(i,x(i,k,t))+sum(j,y(j,k,t))=L=2;
ASIGVR(k,t).. Sum(l,z(l,k,t))=e=1;
new1(k,t).. Sum(i,x(i,k,t))=e=1;
new2(k,t).. Sum(j,y(j,k,t))=e=1;
new3(i,t).. Sum(k,x(i,k,t))=e=1;
new4(j,t).. Sum(k,y(j,k,t))=e=1;
new5(l,t) .. Sum(k,z(l,k,t))=e=1;
Rep1JT(i,k).. Sum(t,x(i,k,t))=1=2;
Rep1TR(j,k).. Sum(t,y(j,k,t))=1=2;
RBALANJT(i) .. SUM((k,t),(x(i,k,t)*Alfa(i,k)))-DmasI(i)+DmenosI(i))=e=90;
RBALANTR(j) .. SUM((k,t),(Y(j,k,t)*Beta(j,k)))-DmasJ(j)+DmenosJ(j))=e=90;
RBALANCAM(l).. SUM((k,t),(Z(l,k,t)*W(k,l)))-DmasL(l)+DmenosL(l))=e=100;
RCFSJT(i).. Sum((k,t), X(i,k,t)*Alfa(i,k))=e=CFJSJT(i);
RCFSTR(j).. Sum((k,t), Y(j,k,t)*Beta(j,k))=e=CFSTR(j) ;
RCFSCAM(l).. Sum((k,t), Z(l,k,t)*W(k,l))=e=CFSCAM(l) ;

Model dummy1 /all/;
Solve dummy1 minimizing ET using MIP;
Display
x.l, y.l, z.l,CFJSJT.l,CFSTR.l,CFSCAM.l,DmasI.l,DmenosI.l,DmasJ.l,DmenosJ.l,DmasL.l,DmenosL.l;

```